
Stimulight: Exploring Social Interaction to Reduce Physical Inactivity among Office Workers

Hans Brombacher

Eindhoven University of Technology
Eindhoven, the Netherlands
j.g.brombacher@student.tue.nl

Dennis Arts

Fontys University of Applied Sciences,
Eindhoven University of Technology,
Eindhoven, the Netherlands
d.arts@fontys.nl

Carl Megens

Eindhoven University of Technology
Eindhoven, the Netherlands
c.j.p.g.megens@tue.nl

Steven Vos

Eindhoven University of Technology,
Fontys University of Applied Sciences
Eindhoven, the Netherlands
s.vos@tue.nl



Figure 1. Design of Stimulight placed within an open office environment

ABSTRACT

Prolonged sitting at the workplace is a growing public health concern. In this paper, we propose the activity-focused design framework which provides an overview of recent work in HCI to stimulate physical activity or to reduce sedentary behavior. Next, based on this framework, we present Stimulight, an intelligent system designed to explore the effect of providing personal and/or social feedback on the activity pattern of office workers. To test the intuitiveness of the feedback modalities of our design, three different feedback conditions were explored in a lab study with 61 participants. Our results show a positive effect of visualizing and sharing physical activity patterns with co-workers. Based on our findings, we present design implications and offer perspectives for future work on how to use social feedback mechanisms to encourage social interaction in the workplace to enhance physically active behavior among office workers.

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Author Keywords

Social feedback; Social interaction; Intervention design; Office environment; Design framework; Physical activity.

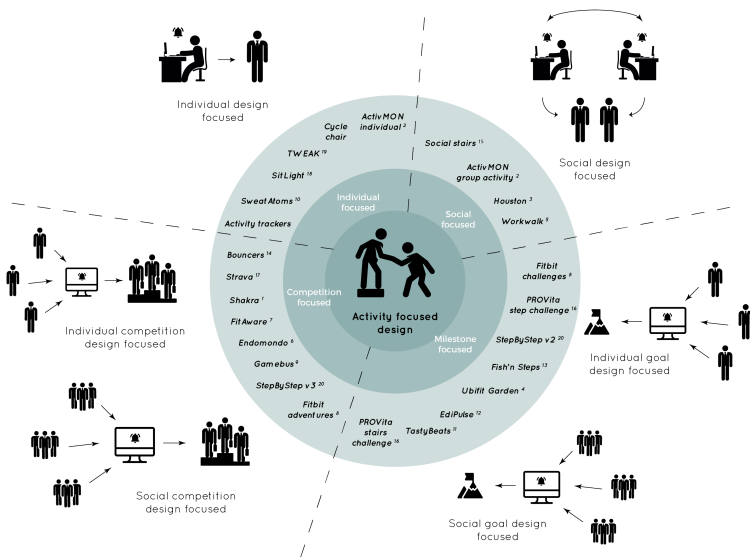


Figure 2. Activity-focused design framework:
A larger version of the framework (including the references) is displayed in the following link.

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1 INTRODUCTION

Physically inactive lifestyles have become a societal challenge. Physical inactivity and excessive sitting have become highly prevalent and cause additional health risks [32]. High levels of inactive behaviour are associated with non-communicable diseases such as type II diabetes, cardiovascular diseases, and breast cancer [4,11,21], resulting in major health-related issues, such as a low quality of life, health inequalities, substantial healthcare costs, and attributable mortality [13,28].

A substantial part of peoples' sedentary behaviour (SB) occurs during work hours [8]. Hence, the workplace has been identified as an important setting to promote physical activity (PA) and to reduce SB [8]. In addition, an active work style has been proven to improve the work performance, workability and self-esteem [1,29] as well as mental health, creativity, increased productivity, stress tolerance and improved decision making [12,35]. An active work style is also related to social participation [27,31]. People develop social relationships and social comparison with others throughout their work. Individuals often compare their actions, such as their work performance and working hours with others [3,10]. To the best of our knowledge, social comparison of PA levels is however not prominently shared in the working environment.

In this paper, we aim to explore if and how social feedback on PA of employees could contribute to employees' activity level throughout their workday. We present Stimulight, a research through design prototype that is designed to provide feedback to office workers on their PA (Figure 1).

2 RELATED WORK: ACTIVITY-FOCUSED DESIGN FRAMEWORK

Stimulating PA and reducing SB in the work environment is an ongoing topic in HCI. In Figure 2 we present the activity-focused design framework which displays a non-exhaustive overview of HCI-related work. The framework distinguishes four types of designs: (i) social focused designs, (ii) individual focused designs, (iii) competition focused designs, and (iv) milestone focused designs. In the next paragraphs, we will highlight some examples regarding these four types of designs.

2.1 Social focused

Social Stairs [18] is an example of social focused design. These interactive stairs were designed to entice people to be more active (together with others) within their work environment. Another example is Workwalk [8] which aims to help office workers to integrate walking into their daily work routine. People can book their work meetings (on a 25-minute walking route) with colleagues (in a socially active work style). On a digital level the "Houston" application provides users with a (non-ranked) overview on the number of steps of their friends [6].

2.2 Individual focused

A different approach was taken within SitLight [23], a shirt designed to give personal feedback on sitting posture and prolonged sitting. Because the individual feedback was visible for others, also a social reaction was seen where other people commented on this feedback. In recent years, multiple trackers and apps have been developed that mostly provide feedback on PA levels.

Three setups (Figure 3) were designed in order to achieve a high experimental contrast. Setup 1 was developed to learn about the difference between the social and individual feedback. Setup 2 was developed to allow the creation of social pressure and/or social support while setup 3 was designed to purely focused on the activity pattern of a colleague and by doing this allowing and/or receiving social support

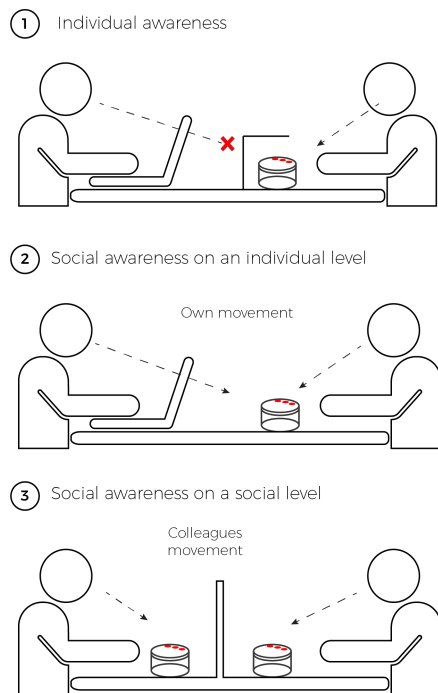


Figure 3. Intervention designs for research setup

These trackers and related platform do however have a high level of engagement based on biophysical parameters. ActivMON [5] was therefore developed to research the effects on real-time displaying of the activity patterns of individuals, both in an individual and within a group.

2.3 Competition focused

Bouncers [15], an example of a competition focused design, visualizes the amount of PA of individuals and their friends and family on the home screens of their smartphones. As a result, people became competitive and socially interactive. A competition focused approach is also seen in the smartphone apps Shakra [2] and StepByStep [34]. Next to giving feedback on an individual level, both apps rank the amount of activity of the user with other individuals. This competitive element was seen a motivational, depending on the personality and level of competitiveness of the users. FitAware [9] is another example of a competition focused design where HCI is applied in the context of a group dynamics-based PA competition. It provides the user, next to an individual overview, with overall and within-group rankings.

2.4 Milestone focused

The Active Team Program [20] aims to improve the PA of employees through PA related group challenges, such as a total number of steps or stairs climbed during a fixed time interval. On a similar, individual level, the designs of Fish'n Steps [14] and Ubifit Garden [7] presented a goal-focused approach within a game where individuals need to unlock items by being active and accomplishing activity goals.

2.5 Activity-focused design framework

With the exemption of individual focused designs, all types of designs in the activity-focused design framework (Figure 2) have to a certain extent, social aspects. Yet, in a work environment, different individuals with different personalities work together leading to employees with different levels of competitiveness [19,22,24]. Applying a competition or milestone focused design intervention could therefore only trigger the already active-minded people, resulting in a lack of participating or early drop out of less active people. In this paper, the choice was therefore made to focus on the social activation/awareness of being physically active, without adding a competition or milestone element.

3 STIMULIGHT: A RESEARCH THROUGH DESIGN PROTOTYPE

A research through design prototype [17,33] 'Stimulight' was developed to facilitate the presentation of the missing social PA feedback/translucence on the work floor. Stimulight visualizes whether an individual/colleague (depending on the social context) has been active enough or not.

3.1 Three different design interventions

We assumed that employees would be more active when colleagues could see their feedback patterns. An experiment with three setups (Figure 3) with different awareness levels was therefore defined to learn about the initial reactions and behaviours of users towards the design of Stimulight.

Setup 1 - Individual awareness: the design is only visible to the user. It gives physical activity feedback about the user on an individual level.

Setup 2 - Social awareness on an individual level: the design is visible for the user and his/her co-workers. It gives physical activity feedback about the user on an individual level.

Setup 3 - Social awareness on a social level: the design gives feedback on the physical activity of a paired co-worker. Users can only see the feedback of a colleague and not on an individual level.

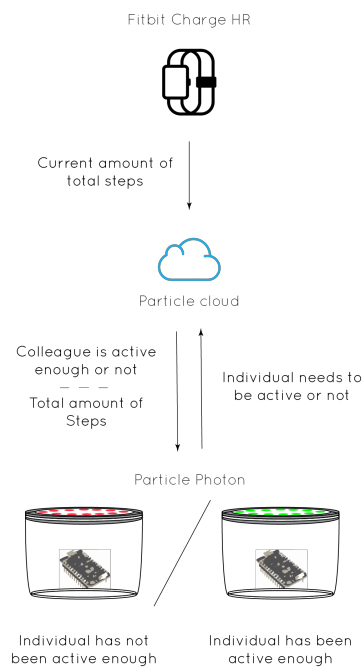


Figure 4. Communication of the design of Stimulight

3.2 Participants and research setup

In total, 61 participants (44% female, mean age 22.8 years) were interviewed in lab setting, using a face-to-face questionnaire (5-15 min). Participants were randomly recruited at Eindhoven University of Technology. The participants were instructed about the purpose of the study and consent was obtained. The three designs interventions were randomly presented in order to avoid order effects. The participants were asked to rate the three design interventions on a 5-point Likert scale (highly seductive – seductive – neutral – coercive - highly coercive). Next, they were asked to rank the three design interventions into a top 3 ordinal scale on the levels of being (i) motivational, (ii) stressful, and (iii) able to creating awareness of being active or not. All participants were asked to qualitatively explain their ratings and rankings and to motivate which intervention design they preferred.

3.3 Data analysis and results

The quantitative data were analysed with SPSS 25.0. One-way ANOVA's (with post hoc testing) were used to investigate differences in scale scores and rankings between the three design interventions. A significance level of $p < 0.05$ was set. A thematic analysis was conducted on the qualitative quotes. The coding was performed manually based on a coding framework that was discussed and checked by a co-investigator. The quotes were divided into five codified topics: feedback on the interaction, overall feedback on the design, possible stress caused by the interaction, motivation to become active caused by the interaction and additional (overall) feedback.

Table 1 gives an overview of the mean scores for both the ratings and the rankings. The intervention of creating social awareness on a social level (setup 3, Figure 3) was seen as the most motivational intervention (Table 1). The interviews confirmed this. For instance, one of the participants said: *"It would motivate me to be active but also to motivate others to be more active"* and *"It would help me with motivating other people to be active..."*. The intervention of giving social feedback on an individual was seen as the most stressful way of giving feedback on being physically active (Table 1). Participants indicated this intervention as motivational, but at the same time stressful due to the fact that: *"I could be ashamed if everyone sees that I need to be active, it does, however, give me a social pressure to be active."* and, *"It gives me a nice overview of when I need to be active or not, but it could also be an indication that I'm not working hard enough"*. Participants also compared the interventions on their level of creating awareness of being active enough or not. The intervention of social feedback on an individual level gave the participants the most awareness of being active or not (Table 1).

4 DISCUSSION AND FUTURE STEPS

Both social interventions (i.e. setups 2 and 3) were experienced as being more motivational than the individual awareness intervention. This is in line with previous research which shows that social factors play an important role in increasing the engagement of individuals to become active [26]. The intervention in which the participants could only see the feedback of a co-worker (setup 3) was seen as creating the least amount of awareness on being active. The participants in our study indicated that they lacked individual feedback. This is in line with Stragier (2017, [25]) who found that engagement in PA platforms requires a combination of both individual and social affordance.

A Particle photon was programmed to control the interaction of the design [16]. The Photon is subscribed to the particle cloud where the data of the Fitbit is published (Figure 4). The program developed for the Photon calculates the number of steps walked within a given time and is compared with a given threshold

	N	Mean (Std. Deviation)			
Individual awareness	61	2.39 (.737)	2.36 (.731)	2.05 (.805)	2.92 (.954)
Social awareness on an Individual level	61	1.92 (.781)	1.48 (.698)	1.56 (.696)	3.74 (1.031)
Social awareness on a Social level	61	1.69 (.786)	2.16 (.757)	2.39 (.737)	2.69 (1.119)
Significance		$p < .05$	$p < .05$	$p < .05$	$p < .05$

Table 1. Mean and standard deviation of the rating: being motivational, stressful and creating awareness (5-point Likert scale) and the ranking (top 3) of the three intervention designs.

This shows the importance of also displaying individual feedback. Only giving feedback on a social level could have limited the needs of the user [30]. These findings should be considered in future design work. We aimed to gain a better insight into the possible effects of social feedback on PA on the work floor. This study was, however, conducted within a lab setting with mostly a specific target group (i.e. students). Moreover, in this study, the number of steps of the participants were implemented by hand. An improved system (figure 5) we recently designed is based on a more flexible design that fits the work environment and work habits of the user. This will improve the experience of the user with the design and give the researcher a richer quantitative data set to learn about possible behavior change on the long term. This system will automatically upload the number of steps and will be used in a more prolonged study to learn if and how Stimulight could instigate behavioral change. The activity-focused design framework gave us guidance, within HCI interventions, on how to design an intervention for the specific needs of our target group (i.e. using social feedback to include less competitive people). Future research should give a better perspective on the impact and use of the framework on PA interventions within the HCI community.

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Figure 5. Improved version of Stimulight, which will be implemented with a longer, more extensive research in the future.

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